

# PATENT ABSTRACTS OF JAPAN

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(71) Applicant : HITACHI LTD

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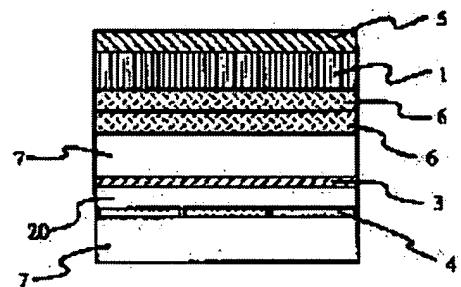
(72) Inventor : KOMURA SHINICHI  
ITO OSAMU  
HIYAMA IKUO

## (54) REFLECTION TYPE LIQUID CRYSTAL DISPLAY ELEMENT

### (57) Abstract:

**PROBLEM TO BE SOLVED:** To obtain excellent diffusing reflection by providing a polarizing plate which is arranged outside a liquid crystal cell, a mirror surface reflecting plate which reflects incident light, and a film which has two kind of extremely small areas having different refractive indexes.

**SOLUTION:** A light control film 1 is a film which functions to scatter light made incident from a specific direction. In this case, a light control film which scatters light that is made incident in the perpendicular direction to the light control film 1 is used to scatter light reflected by a reflection electrode 4, thereby enabling diffusing reflection. As this light control film 1, a film is used which is formed by irradiating a mixture of two kind of ultraviolet-ray setting high polymers with ultraviolet rays. This film structured by laminating layers of high polymers having two kind of refractive indexes. The reflecting electrode 4 is formed of metal such as aluminum. Then STN liquid crystal 20 is applied with the potential difference between a transparent electrode 3 and the reflecting electrode 4. According to the applied voltage, the STN liquid crystal 20 shows different optical characteristics, which are utilized to make a display.



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**DETAILED DESCRIPTION****[Detailed Description of the Invention]**

[0001]

[Field of the Invention] This invention relates to the display which used liquid crystal, especially relates to a reflective mold liquid crystal display.

[0002]

[Description of the Prior Art] In order to realize a bright reflective mold liquid crystal display conventionally, there are the following techniques.

[0003] (1) What attached the reflecting plate which performs hairline processing etc. to STN-LCD and has diffusibility. (2) What gave diffusibility to the light reflex property using the metal which has irregularity in a front face as a pixel electrode (JP,5-323371,A).

[0004]

[Problem(s) to be Solved by the Invention] In the case of the conventional technique (1), the glass substrate of 1mm thickness extent intervenes between a liquid crystal layer and a reflecting plate. Therefore, after the light which penetrated the black display, for example and carried out incidence to the reflecting plate is reflected with a reflecting plate, a white display may be penetrated and a watcher may be reached. In this case, that part serves as a display darker than the normal section. That is, when a black alphabetic character is displayed on a white ground, it will become the display the shadow of an alphabetic character is in sight. Although this problem is solvable by shortening distance of a liquid crystal layer and a reflecting plate, a glass substrate is not easy to have to hold a liquid crystal layer by uniform thickness, and to make it thin.

[0005] This problem is solvable if the conventional technique (2) is used. However, the process for attaching irregularity to an electrode in this case increases, and cost increases. Moreover, the heterogeneity of the image quality resulting from this irregularity also poses a problem.

[0006] The purpose of this invention is to realize the reflective mold liquid crystal display component which shows good diffuse reflection.

[0007]

[Means for Solving the Problem] The reflective mold liquid crystal display component of this invention is arranged ahead of the liquid crystal cell which pinched liquid crystal between the substrates which have the electrode of a pair, the polarizing plate arranged on the outside of said liquid crystal cell, the specular reflection plate which reflects incident light, and a specular reflection plate, and has the film which consists of two kinds of minute fields which have a different refractive index.

[0008]

**[Embodiment of the Invention]**

The configuration of the 1st example of [example 1] this invention is shown in drawing 1. The optical control film 1 is a film which has the function scattered about in the light which carried out incidence from specification. In the case of this example, using the optical control film with which the light which carried out incidence perpendicularly to the optical control film is scattered about, it is scattered about and let light reflected by the reflector 4 be diffuse reflection. The film created by the mixture of two kinds of ultraviolet curing mold macromolecules by irradiating ultraviolet rays as an optical control film is used. this film consists of structure where it was carried out that that is [ product ] right of the layer of a macromolecule with two kinds of refractive indexes. A reflector 4 consists of metals, such as aluminum. Since the optical control film 1 can give diffusibility like point \*\*, the reflector itself may be a mirror plane. Since resistance of a reflector is lower than the case where a transparent electrode is used, it can reduce a cross talk. The potential difference of a transparent electrode 3 and a reflector 4 is impressed to STN LCD 2. With the electrical potential difference impressed, STN LCD 2 shows a different optical property, and displays using this property. In this

example, the thickness of a liquid crystal layer is  $\text{deltan}=0.15$  at 4 micrometers. It carried out. When it is STN-LCD of this method (a polarizing plate is one sheet), contrast is acquired even if the product of thickness and  $\text{deltan}$  is small compared with conventional STN-LCD. Therefore, improvement in the speed is realizable by using the liquid crystal cell of 4 micrometers and a narrow gap like this example. When the electrical potential difference which realizes a black display is impressed between the transparent electrode 3 and the reflector 4, the phase plate 6 of two sheets is set up so that the polarization condition on a reflector 4 may serve as the circular polarization of light, without starting wavelength. It is reflected with a reflecting plate, and a lower phase plate is chosen so that light which penetrated STN LCD 2 again may be made into the elliptically polarized light which does not start wavelength but is inscribed in the same rectangle. An upper phase plate has an optical axis parallel to the long side or shorter side of said rectangle, and it is chosen so that wavelength may not be started but elliptically polarized light inscribed in said rectangle may be made into the linearly polarized light parallel to the absorption shaft of a polarizing plate. Thus, good monochrome display is realizable. As an ingredient of a phase plate 6, form birefringence films which extend a high polymer film and are obtained, such as a polycarbonate film, are used.

[0009] A glass substrate 7 is equipped with a transparent electrode 3 or a reflector 4, and holds STN LCD 2. Plastics etc. can also be used besides a glass substrate. Although it is arrangement of the phase plate which thought the property of a black display as important in this example, it is applicable also to the arrangement which thought the white display as important, or the reflective mold liquid crystal display using the phase plate of only one sheet. When a white display is thought as important, a phase plate is set up so that the polarization condition on a reflector may serve as the linearly polarized light, without starting wavelength. A reflective mold liquid crystal display with good diffusibility is obtained without giving diffusibility to a reflector by using this example.

[0010] The configuration of the 2nd example of [example 2] this invention is shown in drawing 2. The optical control film 1 with which the light which carried out incidence perpendicularly is scattered about like the 1st example is used. The potential difference between the transparent electrodes of a pair is impressed to STN LCD 2. The thickness of a liquid crystal layer is  $\text{deltan}=0.15$  at 6 micrometers. It carried out. The phase plate 6 of two sheets is chosen so that monochrome display may be realized. What vapor-deposited aluminum is used for glass as a specular reflection plate 8. Although this example explained by the case where the phase plate per sheet is in the both sides of STN LCD 2, effectiveness with the same said of the case where there are two phase plates in the case of only one sheet or one side is acquired. A reflective mold liquid crystal display with good diffusibility is obtained without giving diffusibility to a reflector by using this example.

[0011] The configuration of the 3rd example of [example 3] this invention is shown in drawing 3. The optical control film 1 with which the light which carried out incidence perpendicularly is scattered about like the 1st and 2nd example is used. The potential difference between the transparent electrodes of a pair is impressed to STN LCD 2. Thickness of a liquid crystal layer was set to  $\text{deltan}=0.15$  by 6 micrometers. The phase plate 6 of two sheets is chosen so that monochrome display may be realized. What vapor-deposited aluminum is used for glass as a specular reflection plate 8. Effectiveness with the same said of the case where there are two phase plates in the case of only one sheet or one side as well as the 2nd example is acquired. A reflective mold liquid crystal display with good diffusibility is obtained without giving diffusibility to a reflector by using this example.

[0012] The configuration of the 4th example of [example 4] this invention is shown in drawing 4. The optical control film with which the light which carried out incidence perpendicularly like the 1st, 2nd, and 3rd example is scattered about is used. The potential difference between the transparent electrodes of a pair is impressed to the TN liquid crystal 21. Thickness of a liquid crystal layer was set to  $\text{deltan}=0.11$  by 5 micrometers. What vapor-deposited aluminum is used for glass as a specular reflection plate 8. A reflective mold liquid crystal display with good diffusibility is obtained without giving diffusibility to a reflector by using this example.

[0013] The configuration of the 5th example of [example 5] this invention is shown in drawing 5. The optical control film 1 with which the light which carried out incidence perpendicularly is scattered about like the 1st - the 4th example is used. The potential difference of a transparent electrode 3 and a reflector 4 is impressed to the guest host mold liquid crystal 22. Guest host mold liquid crystal is the liquid crystal which mixed dichroism coloring matter. (1) cholesteric liquid crystal, (2) nematic liquid crystals, (3) polymer distributed liquid crystal, (4) liquid-crystal gel (what the macromolecule of a minute amount mixed in liquid crystal), etc. are used for the liquid crystal in this case. A reflector 4 consists of metals, such as aluminum. A reflective mold liquid crystal display with good diffusibility is obtained without giving diffusibility to a reflector by using this example.

[0014] The configuration of the 6th example of [example 6] this invention is shown in drawing 6. It consists of a configuration which carried out the laminating of the phase plate 6 of 5 or 2 polarizing plates, a glass substrate 7, the optical control film 11, a transparent electrode 3, STN LCD 2, a reflector 4, and the glass substrate 7 one by one from the side in which outdoor daylight carries out incidence. The optical control film 11 is a member which has the same

optical property as the optical control film 1. The mixture of a prepolymer is applied to a glass substrate on a spin coat, and it is formed by irradiating ultraviolet rays. In order to obtain reinforcement, it is desirable to perform concomitant use with heat curing. After hardening the optical control film, a transparent electrode is formed by the approach same with forming on a color filter. The formed optical control film consists of a field where a different refractive index is detailed. A reflector 4 consists of metals, such as aluminum. Since the optical control film can give diffusibility, the reflector itself may be a mirror plane. The potential difference of the transparent electrode 3 and reflector 4 of a pair is impressed to STN LCD 2. The thickness of a liquid crystal layer is  $\Delta n=0.15$  at 4 micrometers. It carried out. The phase plate 6 of two sheets is chosen so that monochrome display may be realized. In the case of the example 1, since the optical control film 1 and STN LCD 2 which give diffusibility are separated with the glass substrate 7, the image which the magnitude of a pixel displayed when [ remarkable ] small compared with the thickness of a glass substrate came to have bled. In this example, since the optical control film 1 and STN LCD 2 which give diffusibility are close, this blot is cancelable. Without giving diffusibility to a reflector by using this example, there is good diffusibility and the reflective mold liquid crystal display with which the displayed image does not bleed is obtained.

[0015] In this example, although the optical control film was inserted between the glass substrate and the transparent electrode, it is also an effective approach to serve as the orientation film to which it inserts between a transparent electrode and a liquid crystal layer, and orientation of the liquid crystal is carried out.

[0016] The configuration of the 7th example of [example 7] this invention is shown in drawing 7. The optical control film 1 with which the light which carried out incidence perpendicularly is scattered about like the 1st example is used. The potential difference of the transparent electrode and reflector of a pair is impressed to STN LCD 2. Thickness of a liquid crystal layer was set to  $\Delta n=0.15$  by 4 micrometers. The phase plate 6 of two sheets is chosen so that monochrome display may be realized. A reflector 4 consists of metals, such as aluminum. Without giving diffusibility to a reflector also by using this example, there is good diffusibility and the reflective mold liquid crystal display with which the displayed image does not bleed is obtained. In the above-mentioned examples 1-7, if the optical control film or the optical control film scattered about as an optical control film in the light which carried out incidence from across is used, a reflective mold liquid crystal display with directivity will be obtained. Although the location of an optical control film was pinpointed and explained in the above-mentioned examples 1-7, if arranged at the incidence side of light rather than the member which has a reflex function, the effectiveness of diffuse reflection will be acquired. If above-mentioned examples 1-7 and an above-mentioned color filter are combined, the high reflective color LCD panel of color purity is realizable. A lower glass substrate does not need to be transparent and may use opaque substrates, such as plastics, in the above-mentioned example 1, and 5-7.

[0017]

[Effect of the Invention] According to this invention, it is bright and a shadowless reflective mold liquid crystal display can be offered.

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[Translation done.]

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**CLAIMS****[Claim(s)]**

[Claim 1] The reflective mold liquid crystal display component characterized by having the film which consists of two kinds of minute fields which have a refractive index which is arranged ahead of the liquid crystal cell which pinched liquid crystal between the substrates which have the electrode of a pair, the polarizing plate arranged on the outside of said liquid crystal cell, the specular reflection plate which reflects incident light, and said specular reflection plate, and is different.

[Claim 2] The reflective mold liquid crystal display component characterized by to have the film which consists of two kinds of minute fields which have a different refractive index arranged at the liquid-crystal-cell [ which pinched liquid crystal between the substrate which has a transparent electrode, and the substrate which has a metal electrode ], polarizing plate [ which has been arranged at the substrate side which has said transparent electrode on the outside of said liquid crystal cell ], and substrate side which has said transparent electrode on the outside of said liquid crystal cell.

[Claim 3] The reflective mold liquid crystal display component characterized by having the film which consists of two kinds of minute fields which have a different refractive index arranged between the polarizing plate of the pair arranged as the liquid crystal cell which pinched liquid crystal, and said whose liquid crystal cell were pinched between the substrates which have the transparent electrode of a pair, and said liquid crystal cell and said deflecting plate.

[Claim 4] The reflective mold liquid crystal display component characterized by the ability of liquid crystal to have twisted 180 degrees or more towards the substrate of another side from one substrate in a reflective mold liquid crystal display component given in either of claims 1-3.

[Claim 5] The reflective mold liquid crystal display component characterized by carrying out the laminating of the form birefringence film of at least one sheet to either of claims 1-3 in the reflective mold liquid crystal display component of a publication.

[Claim 6] The reflective mold liquid crystal display component characterized by mixing dichroism coloring matter in either of claims 1-3 in the reflective mold liquid crystal display component of a publication at said liquid crystal.

[Claim 7] The reflective mold liquid crystal display component characterized by carrying out the laminating of the prism array of the shape of a film by which detailed prism has been arranged in a field in a reflective mold liquid crystal display component given in either of claims 1-3.

[Claim 8] The reflective mold liquid crystal display component characterized by carrying out the laminating of the color filter to either of claims 1-3 in the reflective mold liquid crystal display component of a publication.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] The type section Fig. showing the configuration of the component of the 1st example of this invention.

[Drawing 2] The type section Fig. showing the configuration of the component of the 2nd example of this invention.

[Drawing 3] The type section Fig. showing the configuration of the component of the 3rd example of this invention.

[Drawing 4] The type section Fig. showing the configuration of the component of the 4th example of this invention.

[Drawing 5] The type section Fig. showing the configuration of the component of the 5th example of this invention.

[Drawing 6] The type section Fig. showing the configuration of the component of the 6th example of this invention.

[Drawing 7] The type section Fig. showing the configuration of the component of the 7th example of this invention.

[Description of Notations]

1 [ -- A polarizing plate, 6 / -- A phase plate, 7 / -- A glass substrate, 8 / -- A specular reflection plate, 9 / -- A prism array, 20 / -- STN LCD, 21 / -- TN liquid crystal, 22 / -- Guest host mold liquid crystal. ] -- An optical control film, 3 -- A transparent electrode, 4 -- A reflector, 5

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[Translation done.]

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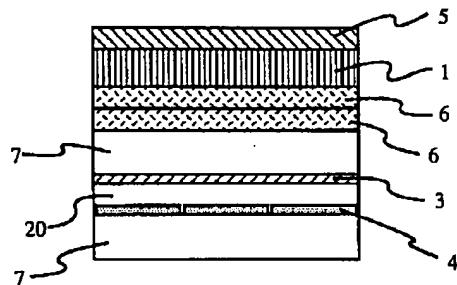
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DRAWINGS

[Drawing 1]

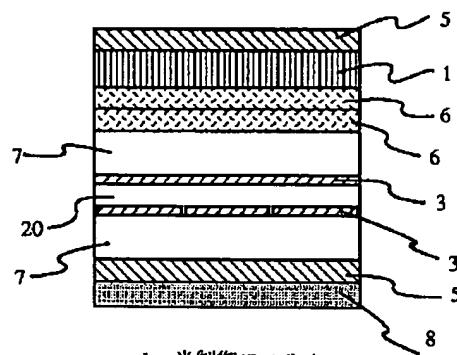
図 1



- 1…光制御フィルム
- 2…STN液晶
- 3…透明電極
- 4…反射電極
- 5…偏光板
- 6…位相板
- 7…ガラス基板

[Drawing 2]

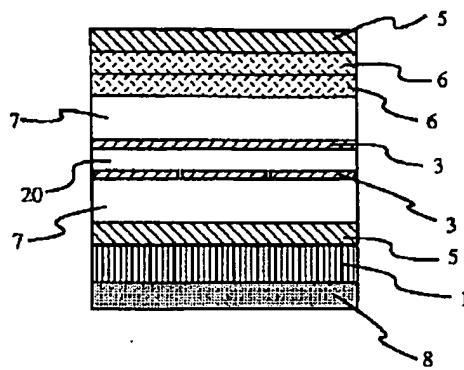
図 2



- 1…光制御フィルム
- 2…STN液晶
- 3…透明電極
- 5…偏光板
- 6…位相板
- 7…ガラス基板
- 8…鏡面反射板

[Drawing 3]

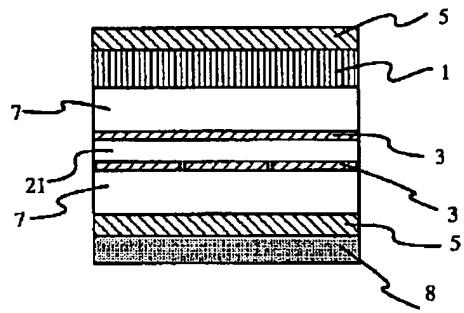
図 3



- 1…光制御フィルム
- 2…STN液晶
- 3…透明電極
- 5…偏光板
- 6…位相板
- 7…ガラス基板
- 8…鏡面反射板

[Drawing 4]

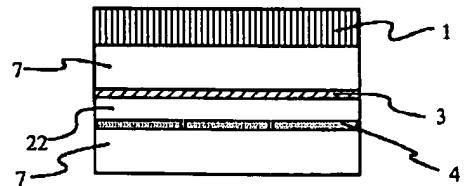
図 4



- 1…光制御フィルム
- 21…TN液晶
- 3…透明電極
- 5…偏光板
- 6…位相板
- 7…ガラス基板
- 8…鏡面反射板

[Drawing 5]

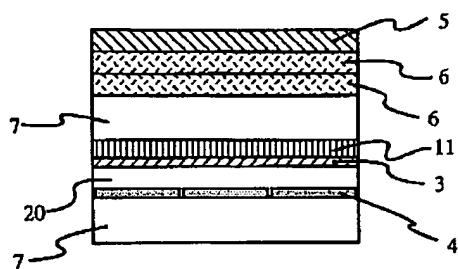
図 5



- 1…光制御フィルム
- 22…ゲストホスト型液晶
- 3…透明電極
- 4…反射電極
- 7…ガラス基板

[Drawing 6]

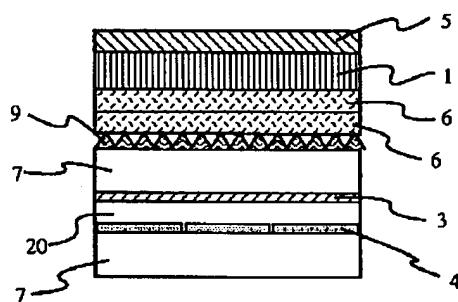
図 6



- 11…光制御膜
- 2…STN液晶
- 3…透明電極
- 4…反射電極
- 5…偏光板
- 6…位相板
- 7…ガラス基板

[Drawing 7]

図 7



- 1…光制御フィルム
- 2…STN液晶
- 3…透明電極
- 4…反射電極
- 5…偏光板
- 6…位相板
- 7…ガラス基板
- 9…プリズムアレイ

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**CORRECTION OR AMENDMENT**

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520  
1/133 500  
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**[FI]**

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[Filing Date] February 17, Heisei 12 (2000. 2.17)

[Procedure amendment 1]

[Document to be Amended] Specification

[Item(s) to be Amended] Claim

[Method of Amendment] Modification

[Proposed Amendment]

[Claim(s)]

[Claim 1] The liquid crystal cell which pinched liquid crystal between the substrates which have the electrode of a pair,

The polarizing plate arranged on the outside of said liquid crystal cell,

The specular reflection plate which reflects incident light,

The reflective mold liquid crystal display component characterized by having the film which consists of two kinds of minute fields which have a refractive index which is arranged ahead of said specular reflection plate, and is different.

[Claim 2] The liquid crystal cell which pinched liquid crystal between the substrate which has a transparent electrode, and the substrate which has a metal electrode,

The polarizing plate arranged at the substrate side which has said transparent electrode on the outside of said liquid crystal cell,

The reflective mold liquid crystal display component characterized by having the film which consists of two kinds of minute fields which have a different refractive index arranged at the substrate side which has said transparent electrode on the outside of said liquid crystal cell.

[Claim 3] The liquid crystal cell which pinched liquid crystal between the substrates which have the transparent electrode of a pair,

The polarizing plate of the pair arranged as said whose liquid crystal cell was pinched,  
The reflective mold liquid crystal display component characterized by having the film which consists of two kinds of minute fields which have a different refractive index arranged between said liquid crystal cells and said deflecting plates.

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[Translation done.]

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(43)公開日 平成9年(1997)5月2日

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	1/133	5 0 0	1/133	5 0 0
	1/137	5 0 0	1/137	5 0 0

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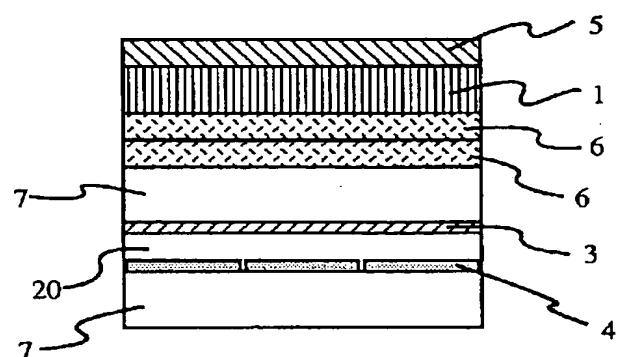
(21)出願番号	特願平7-266683	(71)出願人	000005108 株式会社日立製作所 東京都千代田区神田駿河台四丁目6番地
(22)出願日	平成7年(1995)10月16日	(72)発明者	小村 真一 茨城県日立市大みか町七丁目1番1号 株式会社日立製作所日立研究所内
		(72)発明者	伊東 理 茨城県日立市大みか町七丁目1番1号 株式会社日立製作所日立研究所内
		(72)発明者	桧山 郁夫 茨城県日立市大みか町七丁目1番1号 株式会社日立製作所日立研究所内
		(74)代理人	弁理士 小川 勝男

(54)【発明の名称】 反射型液晶表示素子

(57)【要約】

【課題】影のない、明るい反射型液晶表示素子を提供する。

【解決手段】本発明の反射型液晶表示素子は、一対の電極を有する基板間に液晶を挟持した液晶セルと、前記液晶セルの外側に配置された偏光板と、入射光を反射する鏡面反射板と、鏡面反射板の前方に配置され、異なる屈折率を有する2種類の微小領域から構成されるフィルムとを有する。



- 1…光制御フィルム
- 2…STN液晶
- 3…透明電極
- 4…反射電極
- 5…偏光板
- 6…位相板
- 7…ガラス基板

(2)

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**【特許請求の範囲】**

**【請求項1】** 一対の電極を有する基板間に液晶を挟持した液晶セルと、  
前記液晶セルの外側に配置された偏光板と、  
入射光を反射する鏡面反射板と、  
前記鏡面反射板の前方に配置され、異なる屈折率を有する2種類の微小領域から構成されるフィルムとを有することを特徴とする反射型液晶表示素子。

**【請求項2】** 透明電極を有する基板と金属電極を有する基板との間に液晶を挟持した液晶セルと、  
前記液晶セルの外側で前記透明電極を有する基板側に配置された偏光板と、  
前記液晶セルの外側で前記透明電極を有する基板側に配置された異なる屈折率を有する2種類の微小領域から構成されるフィルムとを有することを特徴とする反射型液晶表示素子。

**【請求項3】** 一対の透明電極を有する基板間に液晶を挟持した液晶セルと、  
前記液晶セルを挟むようにして配置された一対の偏光板と、  
前記液晶セルと前記偏向板の間に配置された異なる屈折率を有する2種類の微小領域から構成されるフィルムとを有することを特徴とする反射型液晶表示素子。

**【請求項4】** 請求項1から3のいずれかに記載の反射型液晶表示素子において、  
液晶が一方の基板から他方の基板に向けて180°以上ねじれていることを特徴とする反射型液晶表示素子。

**【請求項5】** 請求項1から3のいずれかに記載の反射型液晶表示素子において、少なくとも1枚の複屈折性フィルムを積層していることを特徴とする反射型液晶表示素子。

**【請求項6】** 請求項1から3のいずれかに記載の反射型液晶表示素子において、  
前記液晶に二色性色素を混入したことを特徴とする反射型液晶表示素子。

**【請求項7】** 請求項1から3のいずれかに記載の反射型液晶表示素子において、  
微細なプリズムが面内に配置されたフィルム状のプリズムアレイが積層されたことを特徴とする反射型液晶表示素子。

**【請求項8】** 請求項1から3のいずれかに記載の反射型液晶表示素子において、  
カラーフィルタが積層されたことを特徴とする反射型液晶表示素子。

**【発明の詳細な説明】**

**【0001】**

**【発明の属する技術分野】** 本発明は液晶を用いた表示装置に係り、特に反射型液晶表示装置に係る。

**【0002】**

**【従来の技術】** 従来、明るい反射型液晶表示装置を実現

するために、以下のような技術がある。

**【0003】** (1) STN-LCDにヘアライン加工等を施して拡散性を有する反射板を付けたもの。(2)画素電極として表面に凹凸のある金属を用いて光反射特性に拡散性を付与したもの(特開平5-323371号)。

**【0004】**

**【発明が解決しようとする課題】** 従来技術(1)の場合、液晶層と反射板の間に1mm厚程度のガラス基板が介在する。そのため、例えば黒表示部を透過して反射板に

10 入射した光が反射板にて反射された後、白表示部を透過して観測者に達する場合がある。この場合、その部分は正常部よりも暗い表示となる。すなわち、白地に黒い文字を表示した場合に文字の影が見えるような表示になってしまう。この問題は、液晶層と反射板の距離を短くすることによって解決できるが、ガラス基板は液晶層を均一な厚さで保持しなければならず薄くすることは容易ではない。

**【0005】** 従来技術(2)を用いれば、この問題を解決できる。しかし、この場合、電極に凹凸を付けるためのプロセスが増え、コストが増す。また、この凹凸に起因した画質の不均一性も問題となる。

**【0006】** 本発明の目的は良好な拡散反射を示す反射型液晶表示素子を実現することにある。

**【0007】**

**【課題を解決するための手段】** 本発明の反射型液晶表示素子は、一対の電極を有する基板間に液晶を挟持した液晶セルと、前記液晶セルの外側に配置された偏光板と、入射光を反射する鏡面反射板と、鏡面反射板の前方に配置され、異なる屈折率を有する2種類の微小領域から構成されるフィルムとを有する。

**【0008】**

**【発明の実施の形態】**

**【実施例1】** 本発明の第1の実施例の構成を図1に示す。光制御フィルム1は特定方向から入射した光を散乱する機能を有するフィルムである。本実施例の場合、光制御フィルムに対し垂直に入射した光が散乱される光制御フィルムを用いて、反射電極4によって反射された光を散乱し拡散反射とする。光制御フィルムとしては、2種類の紫外線硬化型高分子の混合物に紫外線を照射して作成されるフィルムが用いられる。このフィルムは2種類の屈折率をもつ高分子の層が積重された構造からなる。反射電極4はアルミ等の金属よりなる。先述のように光制御フィルム1で拡散性を付与できるので、反射電極自体は鏡面であっても構わない。反射電極の抵抗は透明電極を用いた場合よりも低いため、クロストークを低減できる。STN液晶2には透明電極3と反射電極4の電位差が印加される。印加される電圧によってSTN液晶2は異なる光学特性を示し、この特性を利用して表示を行う。本実施例では、液晶層の厚さは4μmで $\Delta n = 0.15$ とした。この方式(偏光板が1枚)のSTN-

(3)

3

LCDの場合、従来のSTN-LCDに比べて厚さと $\Delta n$ の積が小さくてもコントラストが得られる。したがって、本実施例のように4μmと狭ギャップの液晶セルを用いることによって高速化が実現できる。2枚の位相板6は黒表示を実現する電圧が透明電極3と反射電極4の間に印加されているとき、反射電極4上における偏光状態が波長に係らずに円偏光となるように設定されている。下側の位相板は反射板で反射され、再度STN液晶2を透過した光を波長に係らず、同一の長方形に内接する楕円偏光とするように選ばれる。上側の位相板は前記長方形の長辺あるいは短辺に平行な光学軸を有し、前記長方形に内接する楕円偏光を波長に係らず、偏光板の吸収軸に平行な直線偏光とするように選ばれる。このようにして、良好な白黒表示が実現できる。位相板6の材料としては、ポリカーボネイトフィルム等、高分子フィルムを延伸して得られる複屈折性フィルムが用いられる。

【0009】ガラス基板7は透明電極3あるいは反射電極4を備え、かつSTN液晶2を保持する。ガラス基板のほかにプラスチック等を用いることもできる。本実施例では、黒表示の特性を重視した位相板の配置であるが、白表示を重視した配置、あるいは1枚だけの位相板を用いた反射型液晶表示装置にも応用できる。白表示を重視した場合には、反射電極上における偏光状態が波長に係らずに直線偏光となるように位相板が設定される。本実施例を用いることによって、反射面に拡散性を付与することなしに、良好な拡散性のある反射型液晶表示装置が得られる。

【0010】【実施例2】本発明の第2の実施例の構成を図2に示す。第1の実施例と同様に、垂直に入射した光が散乱される光制御フィルム1を用いてある。STN液晶2には一対の透明電極間の電位差が印加される。液晶層の厚さは6μmで $\Delta n=0.15$ とした。2枚の位相板6は白黒表示を実現するように選ばれる。鏡面反射板8としてはガラスにアルミを蒸着したもの等が用いられる。本実施例では、STN液晶2の両側に1枚づつの位相板がある場合で説明したが、位相板が1枚だけの場合、あるいは片側に2枚ある場合についても同様の効果が得られる。本実施例を用いることによって、反射面に拡散性を付与することなしに、良好な拡散性のある反射型液晶表示装置が得られる。

【0011】【実施例3】本発明の第3の実施例の構成を図3に示す。第1、第2の実施例と同様に、垂直に入射した光が散乱される光制御フィルム1を用いてある。STN液晶2には一対の透明電極間の電位差が印加される。液晶層の厚さは6μmで $\Delta n=0.15$ とした。2枚の位相板6は白黒表示を実現するように選ばれる。鏡面反射板8としてはガラスにアルミを蒸着したもの等が用いられる。第2の実施例と同様に、位相板が1枚だけの場合、あるいは片側に2枚ある場合についても同様の効果が得られる。本実施例を用いることによって、反射面に

拡散性を付与することなしに、良好な拡散性のある反射型液晶表示装置が得られる。

【0012】【実施例4】本発明の第4の実施例の構成を図4に示す。第1、第2、第3の実施例と同様に垂直に入射した光が散乱される光制御フィルムを用いてある。TN液晶21には一対の透明電極間の電位差が印加される。液晶層の厚さは5μmで $\Delta n=0.11$ とした。鏡面反射板8としてはガラスにアルミを蒸着したもの等が用いられる。本実施例を用いることによって、反射面に拡散性を付与することなしに、良好な拡散性のある反射型液晶表示装置が得られる。

【0013】【実施例5】本発明の第5の実施例の構成を図5に示す。第1～第4の実施例と同様に、垂直に入射した光が散乱される光制御フィルム1を用いてある。ゲストホスト型液晶22には透明電極3と反射電極4の電位差が印加される。ゲストホスト型液晶は二色性色素を混入した液晶である。この場合の液晶には、(1)コレステリック液晶、(2)ネマチック液晶、(3)ポリマー分散型液晶、(4)液晶ゲル(液晶に微量の高分子が混入したもの)等が用いられる。反射電極4はアルミ等の金属よりなる。本実施例を用いることによって、反射面に拡散性を付与することなしに、良好な拡散性のある反射型液晶表示装置が得られる。

【0014】【実施例6】本発明の第6の実施例の構成を図6に示す。外光の入射する側から、偏光板5、2枚の位相板6、ガラス基板7、光制御膜11、透明電極3、STN液晶2、反射電極4、ガラス基板7を順次積層した構成からなる。光制御膜11は、光制御フィルム1と同様の光学特性を有する部材である。ガラス基板にプレポリマーの混合物をスピンドルコートで塗布し、紫外線を照射することによって形成される。強度を得るために熱硬化との併用を行うことが好ましい。光制御膜を硬化した後、カラーフィルタ上に形成するのと同様の方法で透明電極を形成する。形成された光制御膜は異なる屈折率の微細な領域からなる。反射電極4はアルミ等の金属よりなる。光制御膜で拡散性を付与できるので、反射電極自体は鏡面であっても構わない。STN液晶2には一対の透明電極3と反射電極4の電位差が印加される。液晶層の厚さは4μmで $\Delta n=0.15$ とした。2枚の位相板6は白黒表示を実現するように選ばれる。実施例1の場合は、拡散性を付与する光制御フィルム1とSTN液晶2がガラス基板7によって隔てられているため、画素の大きさがガラス基板の厚みに比べて著しく小さい場合には表示した画像がにじんだようになってしまふ。本実施例では、拡散性を与える光制御膜11とSTN液晶2が近接しているため、このにじみが解消できる。本実施例を用いることによって、反射面に拡散性を付与することなしに、良好な拡散性があり、かつ表示した画像がにじまない反射型液晶表示装置が得られる。

【0015】本実施例では、ガラス基板と透明電極の間

(4)

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に光制御膜を挿入したが、透明電極と液晶層の間に挿入し、液晶を配向させる配向膜を兼ねることも有効な方法である。

【0016】【実施例7】本発明の第7の実施例の構成を図7に示す。第1の実施例と同様に、垂直に入射した光が散乱される光制御フィルム1を用いてある。STN液晶2には一対の透明電極と反射電極の電位差が印加される。液晶層の厚さは $4\mu m$ で $\Delta n=0.15$ とした。2枚の位相板6は白黒表示を実現するように選ばれる。反射電極4はアルミ等の金属よりなる。本実施例を用いることによっても、反射面に拡散性を付与することなしに、良好な拡散性が有り、かつ表示した画像がにじまない反射型液晶表示装置が得られる。上記の実施例1から7において、光制御フィルムとして、斜め方向から入射した光を散乱する光制御フィルムあるいは光制御膜を用いれば指向性をもった反射型液晶表示装置が得られる。上記の実施例1から7においては光制御フィルムの位置を特定して説明したが、反射機能を有する部材よりも光の入射側に配置されれば、拡散反射の効果は得られる。上記の実施例1から7とカラーフィルタを組み合わせれば、色純度の高い反射型カラー液晶表示装置が実現できる。上記の実施例1及び5から7では、下側のガラス基板は透明である必要なくプラスチック等の不透明な基板を使用してもよい。

【0017】

【発明の効果】本発明によれば、明るく、影のない、反射型液晶表示装置が提供できる。

## 【図面の簡単な説明】

【図1】本発明の第1の実施例の素子の構成を示す模式断面図。

【図2】本発明の第2の実施例の素子の構成を示す模式断面図。

【図3】本発明の第3の実施例の素子の構成を示す模式断面図。

【図4】本発明の第4の実施例の素子の構成を示す模式断面図。

【図5】本発明の第5の実施例の素子の構成を示す模式断面図。

【図6】本発明の第6の実施例の素子の構成を示す模式断面図。

【図7】本発明の第7の実施例の素子の構成を示す模式断面図。

## 【符号の説明】

1…光制御フィルム、3…透明電極、4…反射電極、5…偏光板、6…位相板、7…ガラス基板、8…鏡面反射板、9…プリズムアレイ、20…STN液晶、21…TN液晶、22…ゲストホスト型液晶。

【図1】

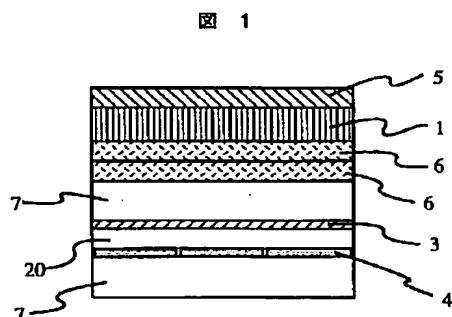
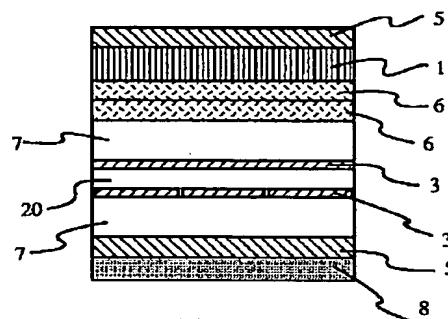


図 1

- 1…光制御フィルム
- 2…STN液晶
- 3…透明電極
- 4…反射電極
- 5…偏光板
- 6…位相板
- 7…ガラス基板

【図2】

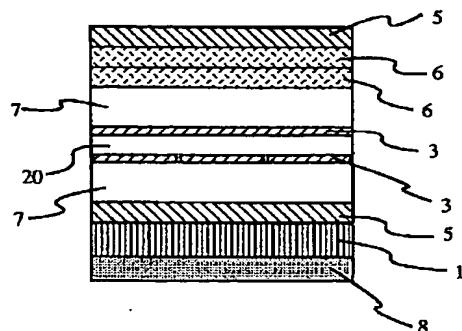


- 1…光制御フィルム
- 2…STN液晶
- 3…透明電極
- 5…偏光板
- 6…位相板
- 7…ガラス基板
- 8…鏡面反射板

(5)

【図3】

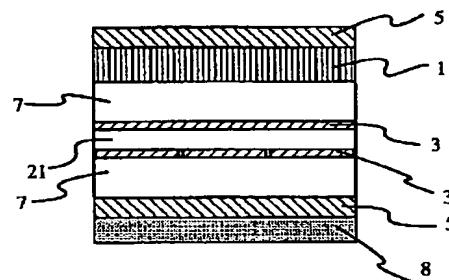
図3



- 1…光制御フィルム
- 2…TN液晶
- 3…透明電極
- 5…偏光板
- 6…位相板
- 7…ガラス基板
- 8…鏡面反射板

【図4】

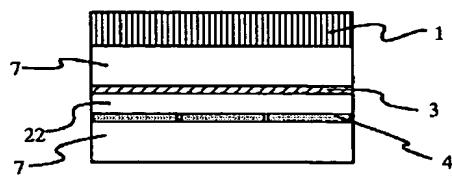
図4



- 1…光制御フィルム
- 21…TN液晶
- 3…透明電極
- 5…偏光板
- 6…位相板
- 7…ガラス基板
- 8…鏡面反射板

【図5】

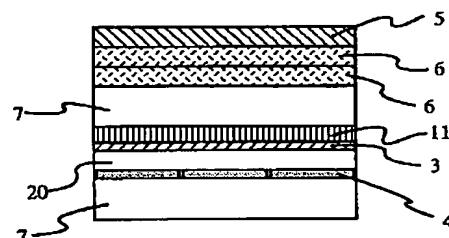
図5



- 1…光制御フィルム
- 22…ゲストホスト型液晶
- 3…透明電極
- 4…反射電極
- 7…ガラス基板

【図6】

図6

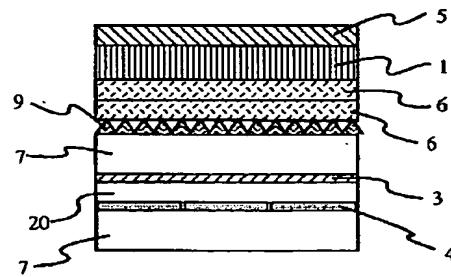


- 11…光制御膜
- 2…TN液晶
- 3…透明電極
- 4…反射電極
- 5…偏光板
- 6…位相板
- 7…ガラス基板

(6)

【図7】

図7



- 1…光制御フィルム  
2…STN液晶  
3…透明電極  
4…反射電極  
5…偏光板  
6…位相板  
7…ガラス基板  
9…プリズムアレイ